A Three Dimensional Graphene Assembly with Hierarchical Pores for Enhanced Electrochemical Detection of Dopamine

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A three dimensional (3D) graphene assembly with hierarchical pores (3DHPG) was prepared by hydrothermal assembly and subsequent carbon-thermal reaction induced etching. The structure and component of the product were characterized by SEM, TEM, Raman, N₂ adsorption-desorption, and XPS. The introduction of mesopores in basal plane of graphene in 3DHPG brings it more edge structure, more oxygen-containing defects, and larger surface area than typical 3D porous graphene foam (3DPG). Electrochemical study revealed the 3DHPG/GCE shows larger current response and improved mass transfer efficiency than 3DPG/GCE. Using dopamine as a model molecule, the 3DHPG/GCE shows much higher current response than that on 3DPG/GCE. The dopamine sensor based on 3DHPG/GCE display a linear range of 0.01- 300 μ M and a detection limit of 3 nM. The linear range is wider than that on 3DPG (0.05-200 μ M), and the detection limit is lower than that on 3DPG (20 nM). The improved sensing performance can be attributed to the hierarchically porous structure with large surface area, efficient mass transfer and enhanced catalysis due to the introduction of mesopores. The 3D hierarchically porous graphene assembly with unique structure and catalysis should be a promising material in electrochemical devices.

Keywords: graphene, hierarchical pore, porous graphene, electrochemical sensor, dopamine

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